

XXVII.—Notes from the St. Andrews Marine Laboratory
(under the Fishery Board for Scotland).—No. XIV. By
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1. On the Ova and Young of *Hippoglossus vulgaris*.
2. On the Ova and Larvæ of *Gadus minutus*.
3. On the Ova and Larvæ of *Brosmius brosme*.
4. On the Ova and Larvæ of *Arnoglossus megastoma*.
5. On a Hermaphrodite Example of *Mytilus modiolus*.

1. *On the Ova and Young of Hippoglossus vulgaris.*

THE ripe eggs of the halibut have hitherto escaped observation. The spawning-period, indeed, even in the case of Fishery Officers stationed where hundreds are landed monthly, is full of uncertainty, so much so that Dr. Fulton, in working up the returns in regard to reproduction, could come to no definite conclusion as to the spawning-period of this species.

Parnell was of opinion that the halibut spawned in spring. J. Couch, again, does not allude to the subject, though R. Couch, according to Day, gives April as the spawning-period. Buckland quotes the statement of Parnell, and adds that the roe is of a pale red colour and the ova numerous, a remark, however, that is applicable to many forms. Day adds nothing to the foregoing. Möbius and Heincke observe that the spawning-period occurs in spring, and state that Malm found on the Cattegat a ripe female on the 26th of April. Fulton, again, procured an advanced specimen, captured east of the Island of May, with the ovaries of a pinkish tinge, on the 18th of February, and others less advanced in June. The eggs in the former case were comparatively large, while in June they measured 1·27 millim. in diameter, but they were far from being ripe, as indeed were various specimens Dr. Fulton kindly forwarded to St. Andrews in May and June, 1891. No ripe example was seen amidst many hundreds from Iceland and Faroë on the pontoon at Grimsby about the middle of the latter month. About the beginning of May, 1892, Mr. Holt, who is carrying out important fishery work at Grimsby, kindly informed me that he had secured the fresh eggs of this species, and that they ranged from 3·07 to 3·81 millim. in diameter, were destitute of an oil-globule, and delicate to handle. The capsule had faint scribbled markings. The eggs collapsed and burst very readily, and he thought it possible that a large perivitelline space was formed after fertilization, as in the long rough dab. They are thus the largest pelagic eggs in our seas; indeed, Raffaele appears to have found none at

Naples over 3 millim. in diameter, though Wenckebach subsequently found one of 4 millim.

Immediately afterwards Dr. Fulton procured ripe eggs by the aid of Mr. R. Mackie, Assistant Fishery Officer, Peterhead, who removed them on the 27th April, 1892, from a fish which had been three days in a boat, which had been fishing on Bergen Bank, about 60 miles off the Fair Isle, and 150 miles E.N.E. from Peterhead. The specimen from which the ova were obtained weighed about 140 lbs., and the ovaries from 18 to 20 lbs. In other examples these organs have reached the weight of 28 lbs. The eggs had been preserved in a strong solution of picric acid, and had shrunk considerably, and the apparently mature were mingled with unripe eggs. The perfectly ripe eggs appeared to be nearly circular, and had a diameter of about 3·3 millim. Those less advanced, though fully 3 millim. in diameter, were more or less ovoid, as usual in unripe eggs; so far as could be ascertained, the comparatively thin *zona radiata* had the same structure as in other pelagic forms, and the external surface is marked by a series of fine creases or folds*. Many of the unripe eggs had a nearly uniform diameter of 1·9050 to 2·0574 millim. Other specimens were received from Dr. Fulton subsequently, and these had a diameter ranging from 3·4290 to 3·7619 millim., and before being immersed in sea-water resembled a slightly milky mass of young Salpæ, or boiled sago.

Mr. R. Duthie, Assistant Fishery Officer, Lerwick, whose zeal in such work deserves commendation, procured a fine series of perfectly ripe eggs on the 5th May, 1893, from a specimen 22 lbs. in weight and about 4 feet long, also captured on Bergen Bank. About half a gallon of ripe eggs was obtained from this fish. These fresh examples demonstrated that the *zona radiata* is of considerable toughness, as Capt. Dannevig also found in the Norwegian examples. Their diameter ranged from 3·0861 to 3·8 millim.

The ripe females of this species, therefore, have chiefly been met with towards the end of April or beginning of May. As in other forms the ripe males are often considerably smaller, some weighing less than 14 lbs., and they arrive at maturity somewhat earlier in the season than the females. It is probable that most of the eggs, which in a given season are ripened and shed in this and allied forms, grow to a size more or less uniform, but considerably less than the diameter of the mature egg; and that the subsequent increase to the

* The usual minute punctures occur all over the surface. The micropyle formed a simple orifice, of a slightly pinkish hue from refraction. No special arrangement of lines or pores surrounded it.

mature condition takes place more rapidly than the previous growth. Such is the general impression, though no exact observations have been made.

The halibut has thus one of the largest and most beautiful of pelagic ova ; but since it has never been obtained in a tow-net, it is possible it may be less buoyant than the smaller eggs.

No fertilized ova having yet been obtained, the larval and the early postlarval stages are unknown. On the 28th of June, however, on Smith Bank, a well-known fishing-ground in the Moray Firth, a closely allied form, if not this species, was procured in the mid-water net along with young gadoids, gurnards, and pleuronectids. The total length is 9·5 millim. and the greatest depth 3·8 millim. It is distinguished by the thickness of the body (the depth of which, however, is comparatively moderate), by the character of the head, and the presence of branchiæ projecting behind the opercula. The thickness and firmness of the body and the condition of the branchiæ would lead to the conclusion that it is not a very young fish, yet the embryonic tail is still present. Before the young turbot reaches that length the condition of its tail is wholly different.

The head is characterized by its massive appearance. The eyes are lateral and of considerable size. The marginal fin is considerably injured, but it seems to have been of moderate depth, traces of true rays appearing both dorsally and ventrally, and especially in the caudal. The terminal curve of the notochord is pronounced but does not taper much, and the embryonic fin apparently forms a shorter lobe than in the other pleuronectids. The vent is situated a little in advance of the median line of the body, which, as well as the head, is speckled with minute blackish-brown points. Those chromatophores present on the abdomen have undergone considerable change, after immersion in spirit, viz. a spreading out of the marginal pigment, while a black speck is left in the centre. The chromatophores on the lateral region occur with some regularity. Indications of two pigment-touches appear in the marginal fin, viz. over the tip of the pectoral, and another about the centre of the post-abdominal region of the body. Ventrally a single patch is situated between the anus and the hypural region. The pigment invades the fin and thus resembles that in the pleuronectids generally. On viewing the dorsal edge from above, the cephalic and the two marginal touches, which extend on the fin, are best seen. Ventrally a little pigment over the abdominal surface and the patch in the anal fin are noticeable, while chromatophores are

dotted round the anus. A few pigment-specks occur inside the abdominal cavity, as viewed from the ventral surface.

The thickness and elongation of the body suggest its relationship with the halibut, and it certainly contrasts strongly with young turbot, somewhat less in size, which were kindly sent for examination by Mr. Holt.

Specimens of very small halibut are extremely rare, apparently because they are found only in deep water near the great fishing-grounds, and because their mouths are too small to take the large hook used for the capture of the species. It is otherwise as soon as it exceeds a foot in length. The smallest examples hitherto examined at St. Andrews were obtained by a local trawler, the larger being a foot and the smaller a little less. On the 31st May, 1892, however, a specimen measuring 97 millim., or a little more than $3\frac{3}{4}$ inches, was procured at a depth of 105 fathoms about 80 miles from the coast of Norway, and about 220 miles from Aberdeen. It had been swallowed by a green cod. Its fin-formula is D. 97, A. 73 (?), caudal 19, pectoral 11, ventral 6, though it must be stated that digestion had considerably affected the fins.

The differences between this small example and that a foot long are the proportionally larger size of the eyes and their proximity to the anterior border of the snout, the smallness of the gape (the posterior angle of the mouth being somewhat in front of the eye, whereas in the larger it passes to the anterior fifth of the eye), and the maxilla is boldly marked. The arch of the lateral line behind the eye on the right is much more pronounced in the larger example, for in the smaller it is gently bent upward, and runs forward with a very slight declivity. On the left side the arch is more distinctly curved. Variations, however, are frequent in the larger examples. The caudal rays proceed from a nearly vertical line in the smaller, from a semicircle (*i. e.* a line convex backward) in the larger specimen. The opercular region also differs, but the gastric juice has affected the small example. The thickness and narrowness of the body are more or less diagnostic at this stage, which, if it pertains to the halibut, is probably about a year old.

2. *On the Ova and Larvæ of Gadus minutus.*

The eggs and larvæ of this species were briefly alluded to by Raffaele*, who stated that the arrangement of the pigment differed from that in the cod. Marion † likewise found

* Mitth. zoolog. Stat. Neap. Bd. viii. Heft 1, sep. Abth. p. 36, Taf. 1. fig. 25, and Taf. 2. figs. 20, 21 (1888).

† Ann. du Musée d'Hist. Nat. de Marseille. Zool. iv. p. 178, pl. 2. fig. 14.

both eggs and larvæ in the Gulf of Marseilles; while Mr. Cunningham* found the adults ripe in April, and the diameter of the eggs 1·02 millim., but he did not hatch them.

At St. Andrews the ripe ova fertilized at 9 A.M. on the 6th June were in the multicelled condition at 5.45 P.M. with a perivitelline space. Their diameter varied from ·9906 millim. to 1·0287 millim. On the 7th the embryo was outlined and the optic vesicles indicated. The eyes of the advanced embryos are silvery, their conspicuous condition being one of the marked features of the egg, and the body, yolk, and head have touches of yellowish pigment. A few were hatched on the 11th June, and the larva measured from 2·3 to 2·4 millim., and somewhat resemble the whiting. The eyes are silvery greenish, the entire head and body being dappled with minute yellow specks. Black chromatophores occur along the ventral border of the muscle-plates, the tip of the tail alone being free from them. A less distinct series runs along the dorsal edge, and a few finely branched specks occur on the head. The rectum terminates blindly at the posterior and upper part of the yolk. In the older larvæ the black pigment had increased along the dorsal and the ventral margins of the muscle-plates. The eyes are silvery by reflected, but have a gorgeous bronzed hue by transmitted light. The yellow specks, moreover, are less conspicuous; indeed in the oldest—that is, in the early post-larval stage (after the disappearance of the yolk)—this pigment appeared only on the cheeks.

Both eggs and larvæ are somewhat delicate, especially in warm weather.

3. *On the Ova and Larvæ of Brosmius brosme.*

The ova of the torsk have a diameter of 1·3335 millim., and are characterized by a zona furnished with a series of boldly marked punctures and a series of intercrossing lines or creases, somewhat like the brill or lemon-dab, and the presence of a large oil-globule of a pale reddish-brown hue under a lens, but pale red by transmitted light, and measuring ·2286 to ·2667 millim. in diameter. The micropyle resembles that of the haddock. They were fertilized in Shetland on the 21st May, and transmitted to the Marine Laboratory, where they were readily hatched. A feature of interest is the fact that the spermaries are comparatively small, even in a male of good size—reaching only from 2 to 3 inches in length, and having the form of small frilled cords. They thus differ

* Journ. Mar. Biol. Assoc. n. s. vol. i. p. 375.

from the male organs of most of the gadoids. The ovaries, on the other hand, are large.

On the fourth day (25th May) the blastopore was closing or closed, the optic vesicles formed, and a broad alar expansion extending outward on each side. A small perivitelline space is present.

Before hatching a greenish-yellow hue by transmitted light appeared on the head and on the tip of the tail. The larva measures about 4 millim., and is characterized by the large pinkish-brown oil-globule which is generally fixed at the posterior border of the yolk. In some the oil-globule, however, is freely movable, and by depressing the tail of the larva it glides forward to the middle of the yolk, while by elevating the head it mounts to the highest point, viz. the anterior border of the yolk. Nothing, indeed, could better illustrate the features formerly pointed out in regard to the movement of the oil-globule in the gurnard, and the passage of the brightly coloured globule through the yolk (not merely at the surface of the yolk as some imagine) was in this instance easily followed. The free condition of the globule was probably abnormal, but it is noteworthy.

The larval torsk is characterized by somewhat irregularly scattered chromatophores on the head, though the front view of the head *in ovo* shows that a more or less symmetrical series is present over each eye. The first patch or bar of finely ramose chromatophores on the trunk is placed rather behind the middle of the yolk, and it is rendered more conspicuous by the black pigment of the sub-notochordal region beneath. The next lies on the muscle-plates behind the vent, the last is at the tip of the tail, while a less definite one is intermediate. A slightly yellowish hue (greenish by transmitted light) pervades the head, yolk-sac, and the tip of the tail. The rectum is near the upper border of the marginal fin. The notochord is multicolumnar. The reddish oil-globule is situated at the posterior border of the yolk.

The changes which subsequently occurred may be summarized as follows:—increase of the greenish-yellow hue and the ramifications of the black chromatophores, increase of pigment in the eyes, which became greenish silvery, absorption of the yolk, and the gradual diminution of the reddish oil-globule, which has been drawn forward and almost concealed under the greatly increased black pigment of the upper region of the abdomen. The appearance of the embryonic rays in the tail was coincident with a more distinct yellowish tint of the marginal fin of that region, and the fan-like expansion of the black pigment of the tail. The larvæ

are very hardy, and could readily be reared in suitable enclosures.

4. *On the Ova and Larvæ of Arnoglossus megastoma.*

The ova were procured from the fishing-grounds off Aberdeen in May, and, as Raffaele pointed out, possess a single oil-globule. They have a diameter of 1.1430 millim., and the oil-globule .3048 millim. All are remarkably buoyant, and at an early stage of development possess a perivitelline space. The zona is distinguished by having elevated lines or ridges with very fine striæ between them, as in the brill and lemon-dab, and these ridges remain after hatching has taken place. The micropyle is sometimes situated in the centre of a radiate series of lines in a space bounded by other ridges. Development is comparatively rapid, so that on the fourth day the perivitelline space has considerably increased—from the diminution of the yolk, the tail of the embryo projects as far as the oil-globule, and its black chromatophores have commenced to ramify. The chromatophores under the oil-globule are minutely branched. The otocysts are formed, and faint pulsations of the heart are present. Some were hatched on the fifth day.

The larva possesses only black pigment somewhat uniformly scattered over the body, with a few specks on the head. They also occur both dorsally and ventrally in the marginal fin, and are V-shaped in the latter. The large oil-globule lies at the posterior and inferior part of the yolk, and in lateral views is somewhat elliptical. The notochord is multicolumnar. The solid strand of the rectum comes to the edge of the marginal fin, and a preanal portion of this fin occurs between it and the yolk. Two days afterwards a yellow pigment appeared amongst the black on the marginal fin and along the sides of the body posteriorly, but in some specimens, which were probably more normal in their emergence, yellow pigment was noticeable on the caudal region. The black pigment in the eyes was late in developing (fifth to sixth day). The mouth opens early, but the mandibular cartilages are less developed than in the gadoids, yet the aperture is proportionally large and the movements extensive. The canary-yellow pigment was conspicuous in the posterior part of the body in the oldest examples.

Briefly, then, the larva is recognized by the characteristic black chromatophores of the marginal fin dorsally and ventrally, the slightly elliptical outline of the oil-globule in lateral view, the pre-anal marginal fin, and the shape of the head.

5. On a *Hermaphrodite* Example of *Mytilus modiolus*.

In examining a series of 'horse'-mussels from Stream Sound, East Burra, Shetland, in February (5th), a specimen measuring $4\frac{1}{4}$ inches was observed to be peculiar. It had a somewhat small ovarian region chiefly developed in front of the posterior adductor, as far as the byssus, and of a tint less bright than usual. In front of the byssus the foot was enlarged and formed a somewhat crescentic elevation of a pale yellowish hue, with a free portion of the foot behind.

On section the ovary—extending, as just mentioned, as far forward as the byssus—presented numerous ova, but also a large amount of degenerating tissue and cells, with reddish-brown bodies and débris, as in the ovary of *Mytilus edulis* during the period of absorption after spawning.

The enlarged region of the foot showed a uniformly minute cellular structure, as in the testis of a male. The cells indeed closely agreed with the sperm-cells, only the mass seemed to have a larger amount of connective tissue.

The mussel had formerly received an injury to the left valve posteriorly, but it had been repaired.

XXVIII.—*Description of a new Siluroid Fish from Burma.*

By G. A. BOULENGER, F.R.S.

Macrones peguensis.

Depth of body $5\frac{1}{2}$ times in total length, length of head $3\frac{1}{2}$ times. Head $1\frac{1}{2}$ as long as broad, slightly granulate above; snout much depressed; diameter of eye 8 times in length of head, interorbital width 3 times; maxillary barbel reaching to middle of pectoral; mandibular barbels subequal, $\frac{2}{3}$ length of head. Vomerine teeth in a crescentic uninterrupted band. No separate interneural shield on the nape. Dorsal I 7; equally distant from end of snout and base of caudal; spine $\frac{2}{3}$ length of head, moderately strong, not serrated; adipose fin as long as dorsal, a little longer than anal. Anal 12. Pectoral spine $\frac{1}{2}$ length of head, strongly serrated on the inner edge; ventral reaching anus; caudal forked. Olive-grey above, white beneath; a series of blackish dotted lines cross the lateral line; dorsal and caudal fins dark, adipose fin blackish.

Total length 20 millim.

Closely allied to *Macrones planiceps*, C. & V., but distinguished by the much shorter barbels.

Two specimens from the Sittang River, near Toungoo; presented to the British Museum by Mr. E. W. Oates.